TABLE 3.—*Free-air resultant winds (meters per second) based on pilot balloon observations made uear 7 a. m. (E. S. T.) during March, 1931*—Continued

Altitude (meters) m. s. l.	Memphis, Tenn. (145 meters)		Modena, Utah (1,665 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. (299 meters)		Phoenix, Ariz. (356 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,294 meters)		San Francisco, Calif. (8 meters)		Sault. Ste. Marie, Mich. (198 meters)		Seattle, Wash. (14 meters)		Spokane, Wash. (606 meters)		Washington, D. C. (10 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°	
Surface	S 69 W	1.0	N 79 W	2.0	N 36 W	1.3	N 21 E	1.7	S 86 E	2.4	N 39 W	1.4	S 4 E	1.7	S 47 E	0.4	N 45 E	1.4	S 19 E	1.5	S 16 E	1.6	N 28 W	2.0
500	N 82 W	1.9	----------	----	N 53 W	3.4	N 17 E	2.0	N 82 E	2.3	N 15 W	2.7	----------	----	N 27 W	2.5	N 51 E	4.3	S 19 W	5.9	----------	----	N 18 W	5.6
1,000	N 69 W	5.5	----------	----	N 71 W	4.2	N 2 W	2.5	N 19 E	1.5	N 5 E	3.1	----------	----	N 14 W	4.9	N 54 E	2.7	S 33 W	6.1	S 30 W	4.3	N 38 W	7.0
1,500	N 67 W	6.9	----------	----	N 77 W	4.7	N 25 W	5.5	N 20 W	1.7	N 1 W	3.7	S 11 E	2.2	N 25 W	4.2	N 41 E	3.3	S 68 W	3.7	S 62 W	4.6	N 52 W	7.2
2,000	N 78 W	7.9	N 13 E	1.3	N 70 W	6.7	N 35 W	7.1	N 46 W	2.5	N 29 W	4.8	S 65 W	1.4	N 28 W	3.8	N 67 E	3.6	S 71 W	3.2	S 86 W	4.9	N 64 W	7.0
2,500	N 71 W	9.0	N 3 W	2.8	N 69 W	9.1	N 33 W	9.0	N 36 W	4.1	N 30 W	5.6	N 69 W	3.5	N 47 W	6.0	N 4 E	3.0	N 2 W	3.1	N 81 W	6.3	N 59 W	8.0
3,000	----------	----	N 20 W	4.8	N 80 W	9.9	N 45 W	10.0	N 39 W	5.6	N 44 W	6.0	N 56 W	5.5	N 56 W	5.9	N 20 W	4.1	N 4 E	5.9	N 89 W	6.2	N 64 W	9.2
4,000	----------	----	N 45 W	9.1	----------	----	N 34 W	12.4	N 49 W	6.2	N 61 W	8.4	N 52 W	6.0	N 43 W	5.1	N 12 E	5.7	----------	----	----------	----	N 78 W	13.4
5,000	----------	----	N 48 W	13.1	----------	----	----------	----	----------	----	----------	----	N 19 W	11.4	----------	----	N 28 W	6.4	----------	----	----------	----	----------	----

TABLE 4.—*Observations by means of kites, captive and limited height sounding balloons during March, 1931*

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.
Mean altitudes (meters), m. s. l., reached during month	2,608	2,517	3,184	2,222	2,864
Maximum altitude (meters), m. s. l., reached	4,498	4,493	4,998	4,264	[1] 9,445
Number of flights made	34	33	33	30	33
Number of days on which flights were made	30	31	28	30	30

In addition to the above, there were approximately 176 pilot balloon observations made daily at 60 Weather Bureau stations in the United States.

[1] Limited-height sounding balloon observation.

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By M. C. BENNETT

GENERAL SUMMARY

The weather for March, as a whole, was persistently cool throughout the central and southern portions of the country from the Rocky Mountains eastward to the Atlantic, while the northern and western sections were warm for the season; however, during the last week a severe cold wave overspread the northwestern and central-western areas, and in some sections the lowest temperatures of the winter occurred during this period, with heavy snow as far south as northwestern Texas.

For the month as a whole the precipitation continued below normal in most sections east of the Great Plains and in large areas west of the Rocky Mountains. The Pacific Northwest, the Great Plains and the extreme Southeast, and the North Atlantic section had much more than the average, while a few localities received nearly twice the normal. The greatest shortage occurred from the Ohio Valley southward nearly to the Gulf and in the far Southwest, especially the lower Colorado Valley, Nevada, and southern California.

TEMPERATURE

The first decade of March was mainly warmer than normal near the Pacific coast and in the northern portion of the country, but colder than normal in the middle and southern portions from the Sierra crest to the Atlantic coast. The period from the 6th to 9th was especially cold in the middle and southern Plateau, Rocky Mountain, and Plains regions.

The fortnight from the 11th to the 24th was mostly warmer than normal in the western half of the country and from Minnesota to New England, but colder than normal in the middle and southern portions of the eastern half, especially the South Atlantic and East Gulf States.

The final week of March was marked almost everywhere by cold weather, especially from the western Plateau to the Mississippi River. The districts from the Black Hills southward to northwestern Texas and central Oklahoma averaged at least 15° colder than normal. However, most of California and the Northeast continued warmer than normal.

The month averaged warmer than normal in the Pacific States and a large part of the Plateau region, also in the northernmost third of the country. The northern portions of New England and New York and the vicinity of Lake Superior and the Red River of the North averaged mainly 4° to 6° above normal. The most marked excess of the monthly temperature was in southwestern California, where Los Angeles noted a mean of 66°, over 8° above normal, making this not only the warmest March but warmer than any recorded April or May.

From New Mexico and eastern Utah eastward to the Atlantic coast from Delaware Bay to Florida the month averaged colder than normal, and to the southward of the Potomac and Ohio Rivers and the southern parts of Missouri and Kansas the deficiency averaged 4° to 7°. In Florida it was almost the coldest March ever known.

The highest marks were generally not notable for March, but one station each in Arizona and California noted 100°. In many States, even as far south as Missouri and Virginia, no temperature exceeding 70° was recorded. In the western half the highest temperatures usually occurred about the 22d, near the Mississippi River about the 13th, but from Michigan and the middle Ohio Valley eastward between the 23d and the 28th.

The lowest readings were considerably below zero in the northernmost States and as far south as Nebraska; also in

most mountain and plateau States. In the eastern half the coldest weather came usually about the 4th or else early in the second decade. Most of the western half experienced its coldest weather about the 27th. At Havre, Mont., −4°, on March 26, was lower than any reading since November 15, last, save one day in January when the same mark was noted.

PRECIPITATION

The monthly amounts of precipitation are given in Table 1, p. 134.

During the first decade there was precipitation in moderate amounts over much of the eastern half of the country, the amounts being especially heavy in the region of the central valleys, and fairly heavy near Lake Michigan and the east Gulf and New England coasts.

The fortnight from the 10th to the 24th brought light to moderate amounts to numerous areas, especially the Pacific Northwest, the northern Plains and thence eastward as far as the western end of Lake Superior and much of Texas and the South and Middle Atlantic States.

The final week brought more precipitation to a large part of the country than any preceding week of March. Most districts received moderate to considerable amounts, save the Rio Grande Valley and areas westward to the south Pacific coast, a broad belt from Montana to Minnesota, and the upper Ohio Valley and the Carolinas.

As a whole, March brought considerably more moisture than any of the months just preceding, and the distribution was comparatively favorable. No State received twice the normal March quantity, on the average, and only in Arizona and California was less than half the normal received.

There usually was more than normal in Washington, Oregon, and Idaho, especially in the western part of the last named and near the lower Columbia River. Much of New Mexico and Texas, nearly all of the Plains, several parts of the Lake region, and most of the upper Mississippi Valley had somewhat more precipitation than normal. Southern Florida received much more rain than normal, and the rest of the east Gulf coast region a trifle more, while from Chesapeake Bay to Maine there was a moderate excess of precipitation.

There was a considerable deficiency from the central portions of Georgia, Alabama, and Mississippi northward to northern Ohio and Indiana; likewise in most of the middle and northern Rocky Mountain regions. The chief area of marked shortage embraced the middle and southern Plateau and Pacific regions, the scarcity of rain being notable in southwestern Arizona and far southern California.

A few stations in Oregon and Washington measured about 30 inches during March, but east of the Pacific States the greatest amount reported was 9.25 inches at a station in Florida. In Maryland, where the monthly precipitation averaged above normal for the first time since November, 1929, every station measured more than 3 inches, while in Kentucky and the Virginias, where once more the average was less than normal, the distribution was yet so favorable that the least amount reported was 1.54 inches.

SNOWFALL

The month's snowfall (see Table 1 and Chart VII) was more than normal over most central and north-central portions, and was usually greater than for any preceding month of the winter. From Kansas to the middle Ohio Valley the quantities were generally more than twice the normal, and in the Lake region, New England, and the western half of the Middle Atlantic States somewhat greater than normal.

The eastern half of the Middle Atlantic States had less than normal and the same was true of Tennessee. Minnesota likewise received somewhat less than normal.

In the far West there was comparatively little snowfall, and the elevated portions of central and southern California received particularly little. Parts of Idaho, however, and much of the Rocky Mountain region received moderately heavy falls, with somewhat improved outlook resulting as to the water supply of the coming season.

The most important falls of snow occurred from eastern Kansas to western New York about the 5th to the 11th, and over most of the Rocky Mountain and Plains regions and part of the Great Basin during the final week. This latter storm gave notable large amounts in the western portion of the central and southern Plains, where the snowfall was accompanied by intense winds and very low temperatures.

SUNSHINE AND RELATIVE HUMIDITY

Much cloudy weather prevailed from the eastern Great Plains eastward, except in the South. It was unusually cloudy in the upper Ohio Valley, the lower Lake and central Appalachian regions. Parkersburg, W. Va., reports the cloudiest month of record. In the Gulf States 50 per cent or more sunshine prevailed, while in the far Southwest from 70 to 80 per cent or more was received. In the central and northern Great Plains, and eastward to the Atlantic the relative humidity was generally above normal, except in Iowa and portions of adjacent States; while elsewhere it was generally below the average. The departures as a rule were not large, except in a few localities in the far West.

SEVERE LOCAL STORMS, MARCH, 1931

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annua Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Ventnor and Atlantic City, N. J.	4					Gale and high tide.	Part of pier swept away; boardwalk damaged.	Washington Post (D. C.).
Long Island, N. Y	4					do	Seaside cottages damaged; greatest havoc at East Hampton.	Washington News (D. C.).
New England coast	4				$2,000,000	Wind and storm tides.	Several towns partly inundated; cottages wrecked; merchandise soaked; roads washed out; traffic stalled. Severest damage between Boston and Salem, Mass.	Evening Star (Washington, D. C.).
North-central States (parts of).	5-9					Snow, wind, glaze	Wires, poles, and trees damaged; highways obstructed; trains off schedule.	Official, U. S. Weather Bureau
Bossier City, La	6	8 p. m.	66-440		5,000	Tornado	5 buildings practically demolished; telephone poles blown down; path 3 miles long.	Do.
Memphis, Tenn	7					High wind	Steamer George Woods sunk	Do.
Asbury Park to Sandy Hook, N. J.	8				75,000	Wind and high tides.	Chief damage by water, character not reported.	Do.